US009019290B2

(12) **United States Patent**
Suzuki et al.

(10) **Patent No.: US 9,019,290 B2**
(45) **Date of Patent: Apr. 28, 2015**

(54) **INFORMATION PROCESSING APPARATUS, INFORMATION PROCESSING SYSTEM, INFORMATION PROCESSING METHOD AND PROGRAM**

(75) Inventors: **Mamoru Suzuki**, Kanagawa (JP); **Yoshihito Ishibashi**, Tokyo (JP)

(73) Assignee: **Sony Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1053 days.

(21) Appl. No.: **12/331,584**

(22) Filed: **Dec. 10, 2008**

(65) **Prior Publication Data**

US 2009/0201304 A1 Aug. 13, 2009

(30) **Foreign Application Priority Data**

Feb. 8, 2008 (JP) 2008-029739

(51) **Int. Cl.**

G06T 1/60	(2006.01)
G09G 5/00	(2006.01)
H04Q 1/38	(2006.01)
G06K 19/07	(2006.01)
G06K 19/077	(2006.01)

(52) **U.S. Cl.**

CPC ***G06K 19/0723*** (2013.01); ***G06K 19/07703*** (2013.01)

(58) **Field of Classification Search**

CPC G06F 17/2288; G06F 17/30011; G06F 21/572; G06F 2221/2141; G06T 1/60; G09G 5/00; H04Q 1/138; H04Q 2209/47

USPC 340/644

See application file for complete search history.

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Primary Examiner — David Zarka
Assistant Examiner — Phong Nguyen
(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

A detecting section which detects a carrier wave near the receiving section, a switching control section which controls a switching section so as to, when the detecting section detects the carrier wave, switch connecting destination of the first storage section into the receiving section, and when the detecting section does not detect the carrier wave, switch the connecting destination of the first storage section into the reading section, a second storage section which stores the data conversion information read by the reading section, and a display control section which converts the read display data using the data conversion information stored in the second storage section so as to display the information on the display section are provided.

16 Claims, 9 Drawing Sheets

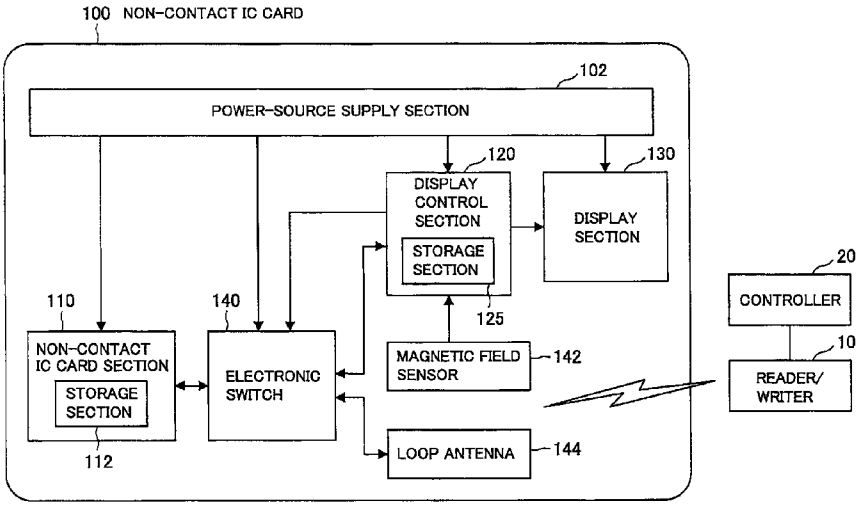

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FIG.1

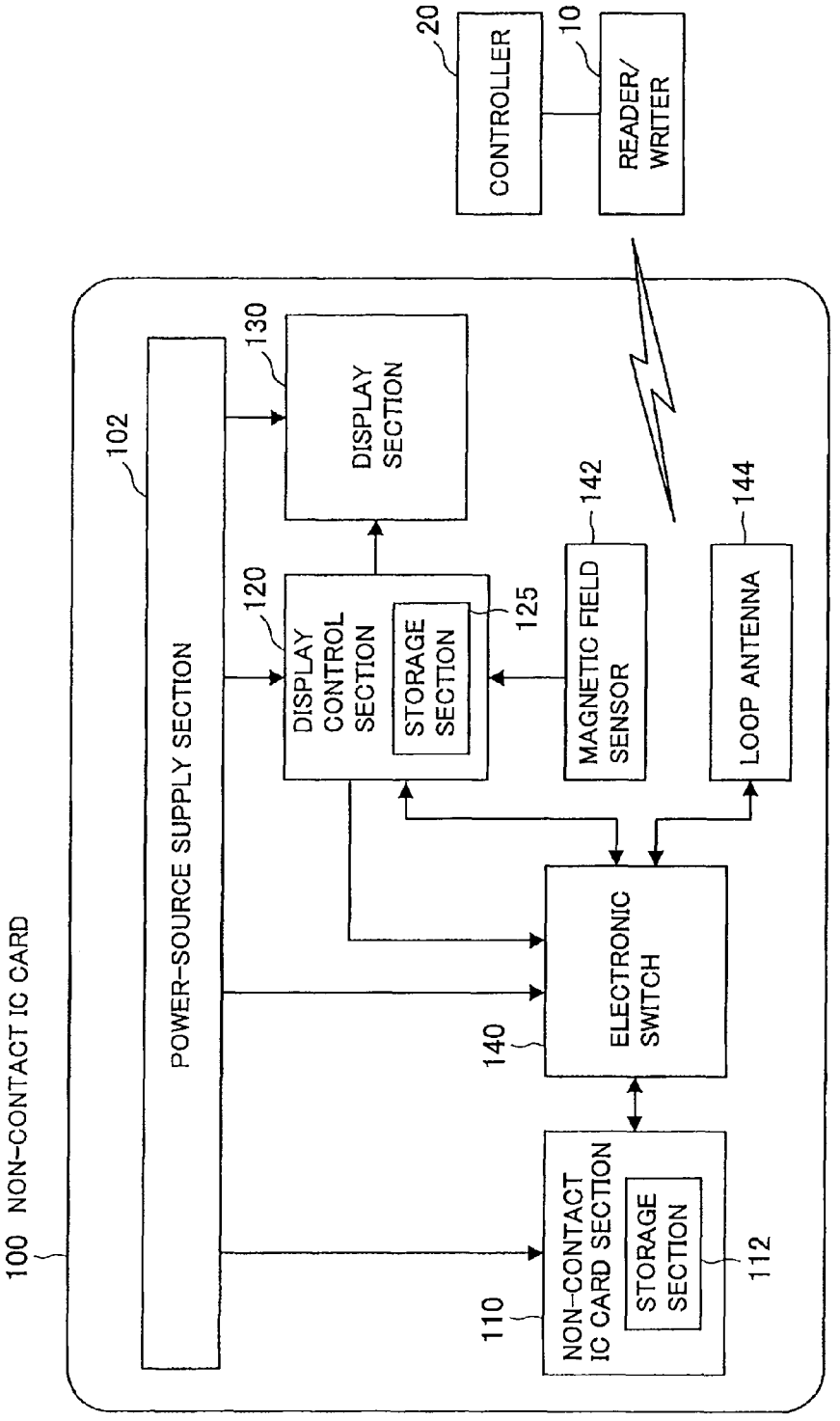

20
CONTROLLER
10
READER/
WRITER
100 NON-CONTACT IC CARD
102
POWER-SOURCE SUPPLY SECTION
130
DISPLAY
SECTION
120
DISPLAY
CONTROL
SECTION
STORAGE
SECTION
125
142
MAGNETIC FIELD
SENSOR
144
LOOP ANTENNA
140
ELECTRONIC
SWITCH
110
NON-CONTACT
IC CARD SECTION
STORAGE
SECTION
112

FIG.2

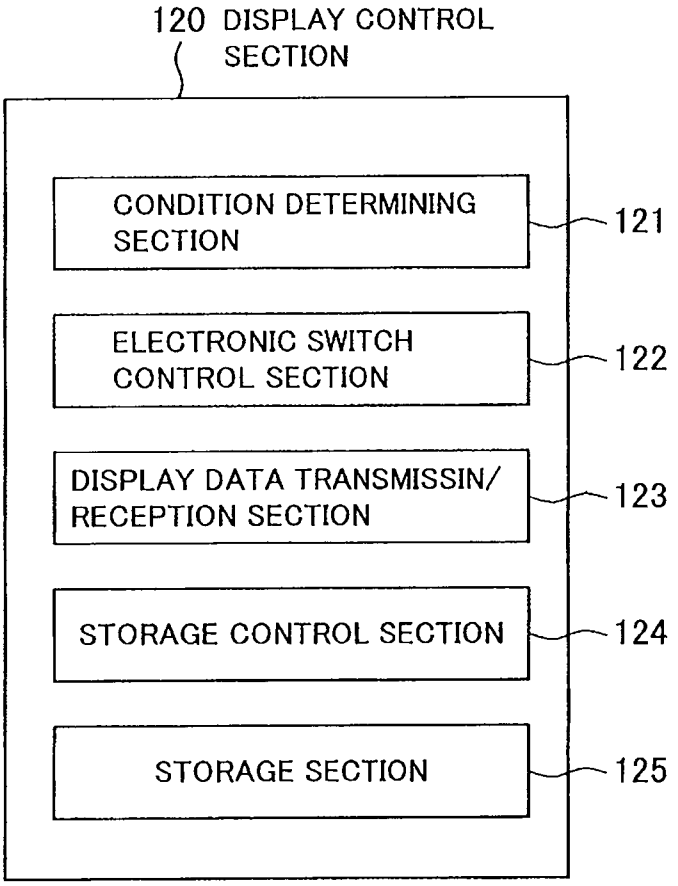

120 DISPLAY CONTROL SECTION
CONDITION DETERMINING SECTION
121
ELECTRONIC SWITCH CONTROL SECTION
122
DISPLAY DATA TRANSMISSIN/ RECEPTION SECTION
123
STORAGE CONTROL SECTION
124
STORAGE SECTION
125

FIG.3

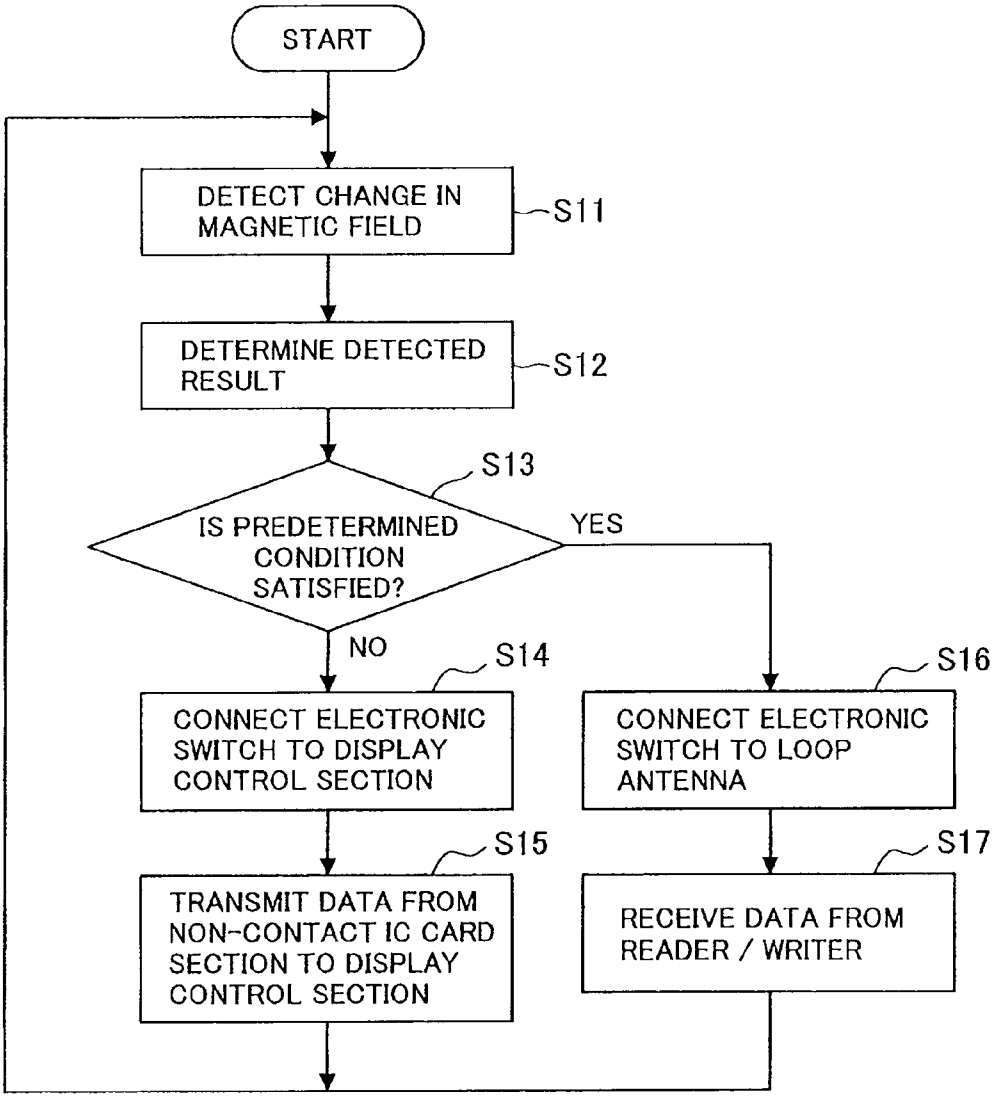
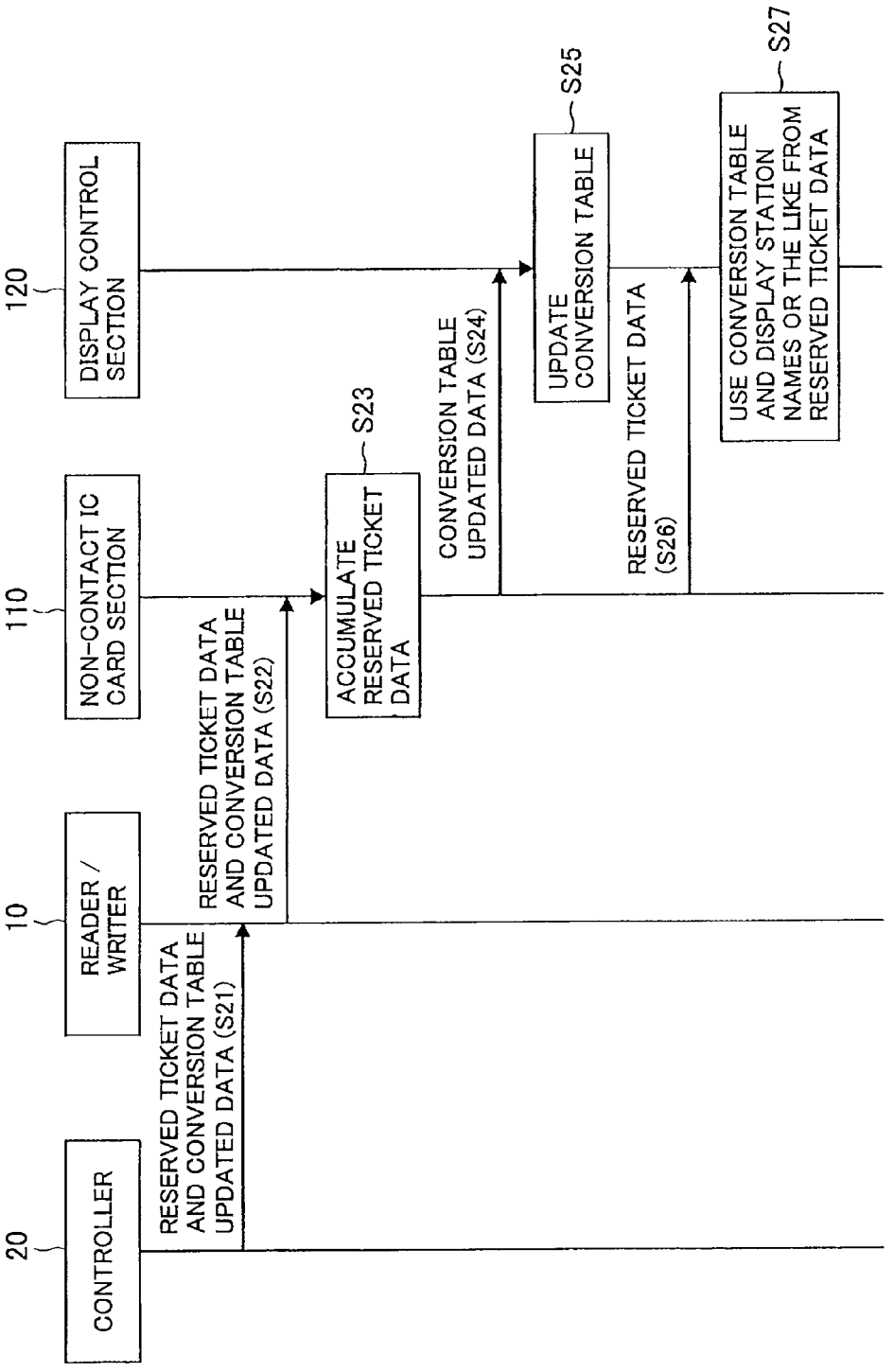

START
DETECT CHANGE IN MAGNETIC FIELD
S11
DETERMINE DETECTED RESULT
S12
S13
IS PREDETERMINED CONDITION SATISFIED?
YES
NO
S14
CONNECT ELECTRONIC SWITCH TO DISPLAY CONTROL SECTION
S15
TRANSMIT DATA FROM NON-CONTACT IC CARD SECTION TO DISPLAY CONTROL SECTION
S16
CONNECT ELECTRONIC SWITCH TO LOOP ANTENNA
S17
RECEIVE DATA FROM READER / WRITER

FIG.4


20
CONTROLLER
10
READER / WRITER
110
NON-CONTACT IC CARD SECTION
120
DISPLAY CONTROL SECTION
RESERVED TICKET DATA AND CONVERSION TABLE UPDATED DATA (S21)
RESERVED TICKET DATA AND CONVERSION TABLE UPDATED DATA (S22)
S23
ACCUMULATE RESERVED TICKET DATA
CONVERSION TABLE UPDATED DATA (S24)
S25
UPDATE CONVERSION TABLE
RESERVED TICKET DATA (S26)
S27
USE CONVERSION TABLE AND DISPLAY STATION NAMES OR THE LIKE FROM RESERVED TICKET DATA

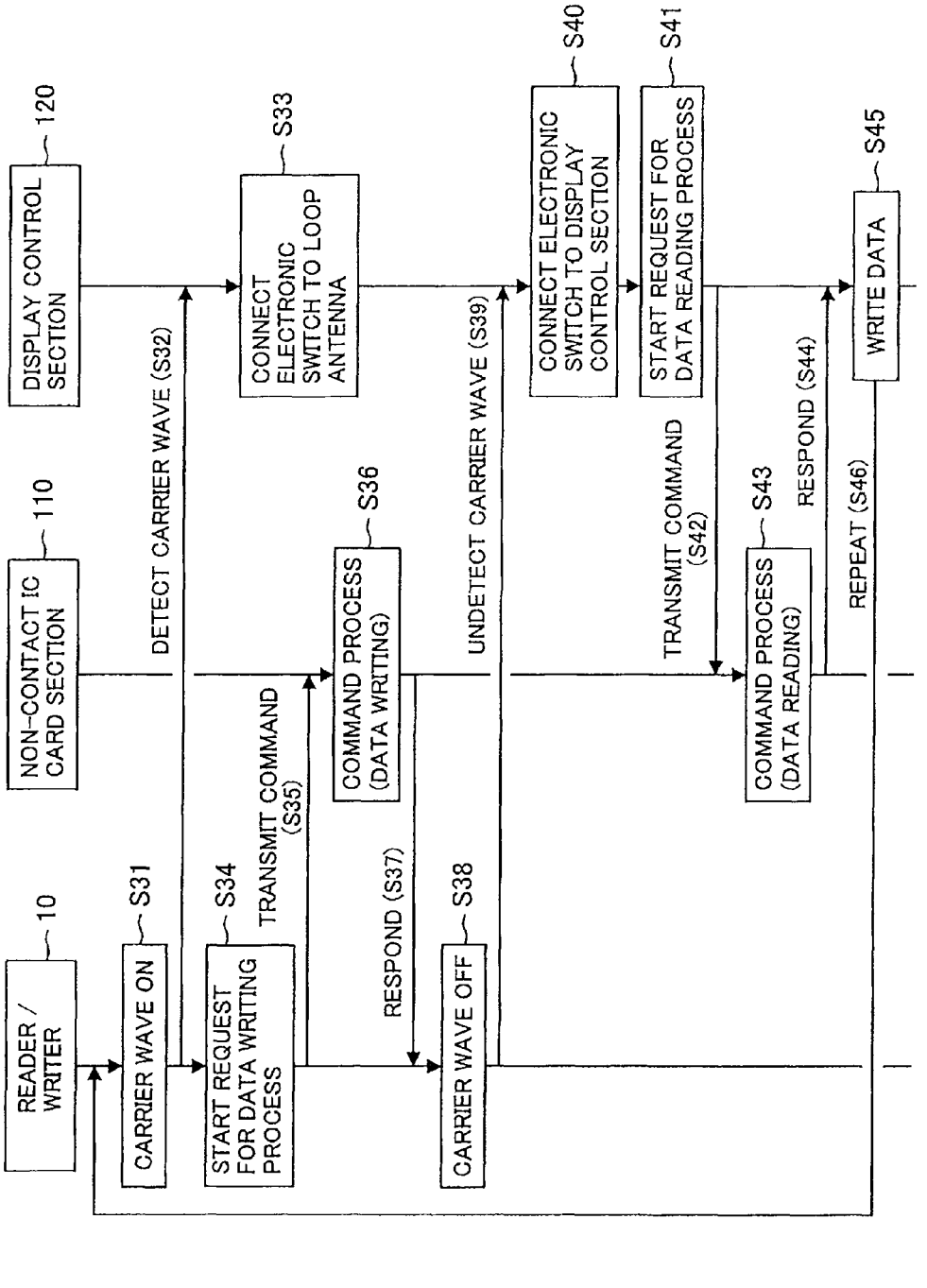

READER / WRITER
10
NON-CONTACT IC CARD SECTION
110
DISPLAY CONTROL SECTION
120
CARRIER WAVE ON
S31
DETECT CARRIER WAVE (S32)
CONNECT ELECTRONIC SWITCH TO LOOP ANTENNA
S33
START REQUEST FOR DATA WRITING PROCESS
S34
TRANSMIT COMMAND (S35)
COMMAND PROCESS (DATA WRITING)
S36
RESPOND (S37)
CARRIER WAVE OFF
S38
UNDETECT CARRIER WAVE (S39)
CONNECT ELECTRONIC SWITCH TO DISPLAY CONTROL SECTION
S40
START REQUEST FOR DATA READING PROCESS
S41
TRANSMIT COMMAND (S42)
COMMAND PROCESS (DATA READING)
S43
RESPOND (S44)
WRITE DATA
S45
REPEAT (S46)

FIG.5

FIG.6

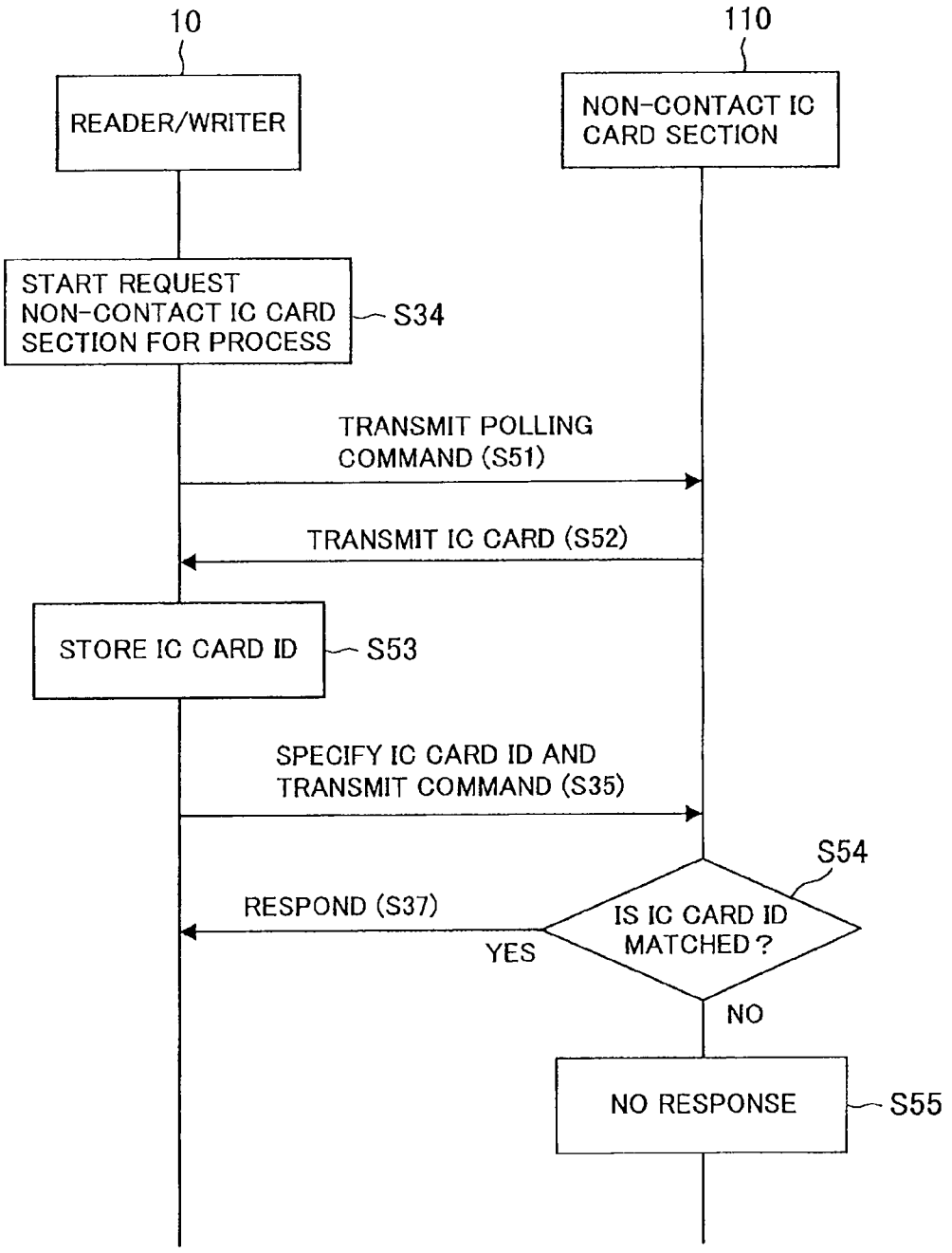
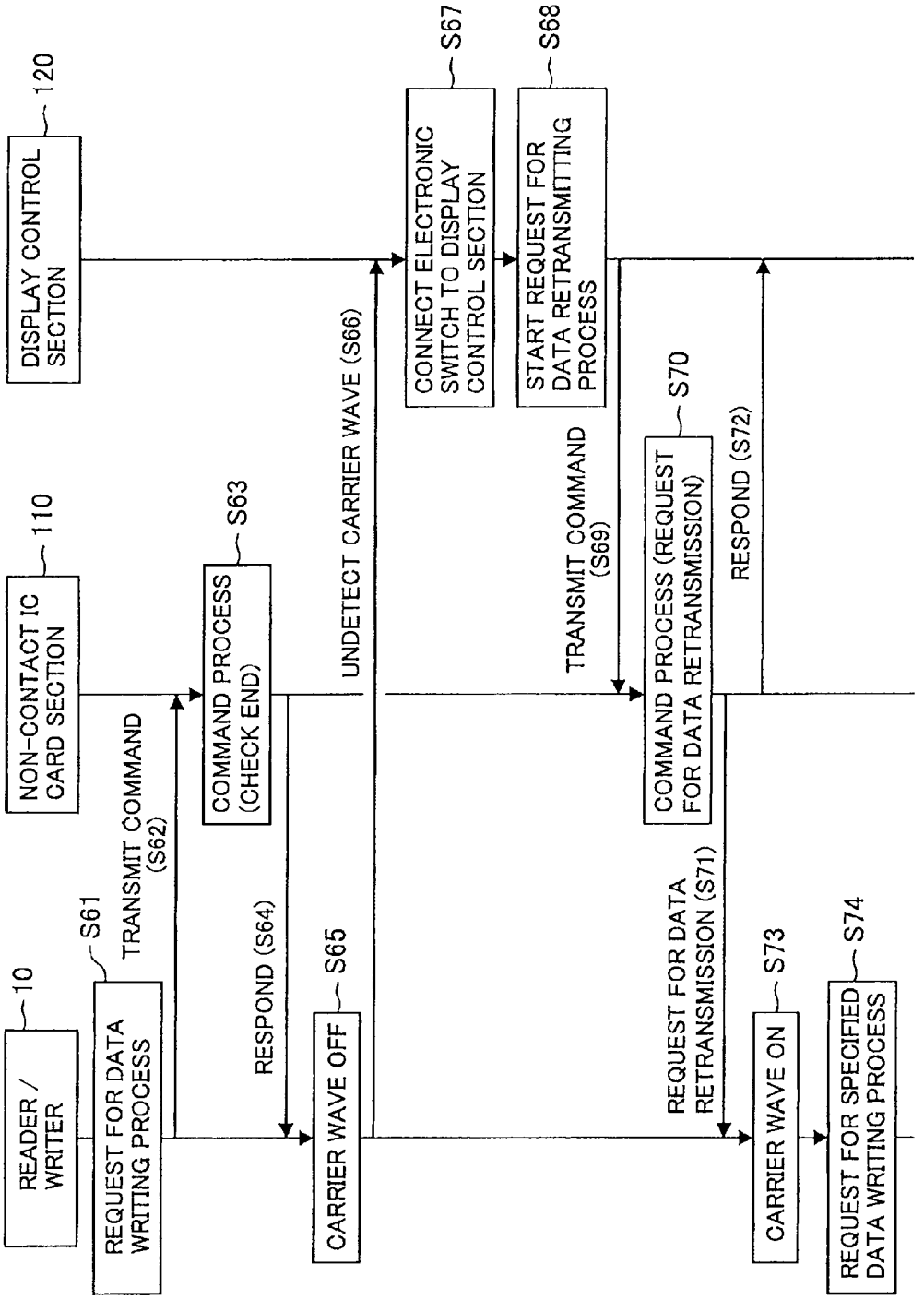

10
110
READER/WRITER
NON-CONTACT IC CARD SECTION
START REQUEST NON-CONTACT IC CARD SECTION FOR PROCESS
S34
TRANSMIT POLLING COMMAND (S51)
TRANSMIT IC CARD (S52)
STORE IC CARD ID
S53
SPECIFY IC CARD ID AND TRANSMIT COMMAND (S35)
S54
IS IC CARD ID MATCHED?
RESPOND (S37)
YES
NO
NO RESPONSE
S55

FIG.7


10
READER / WRITER
S61
REQUEST FOR DATA WRITING PROCESS
TRANSMIT COMMAND (S62)
110
NON-CONTACT IC CARD SECTION
S63
COMMAND PROCESS (CHECK END)
RESPOND (S64)
S65
CARRIER WAVE OFF
UNDETECT CARRIER WAVE (S66)
120
DISPLAY CONTROL SECTION
S67
CONNECT ELECTRONIC SWITCH TO DISPLAY CONTROL SECTION
S68
START REQUEST FOR DATA RETRANSMITTING PROCESS
TRANSMIT COMMAND (S69)
S70
COMMAND PROCESS (REQUEST FOR DATA RETRANSMISSION)
RESPOND (S72)
REQUEST FOR DATA RETRANSMISSION (S71)
S73
CARRIER WAVE ON
S74
REQUEST FOR SPECIFIED DATA WRITING PROCESS

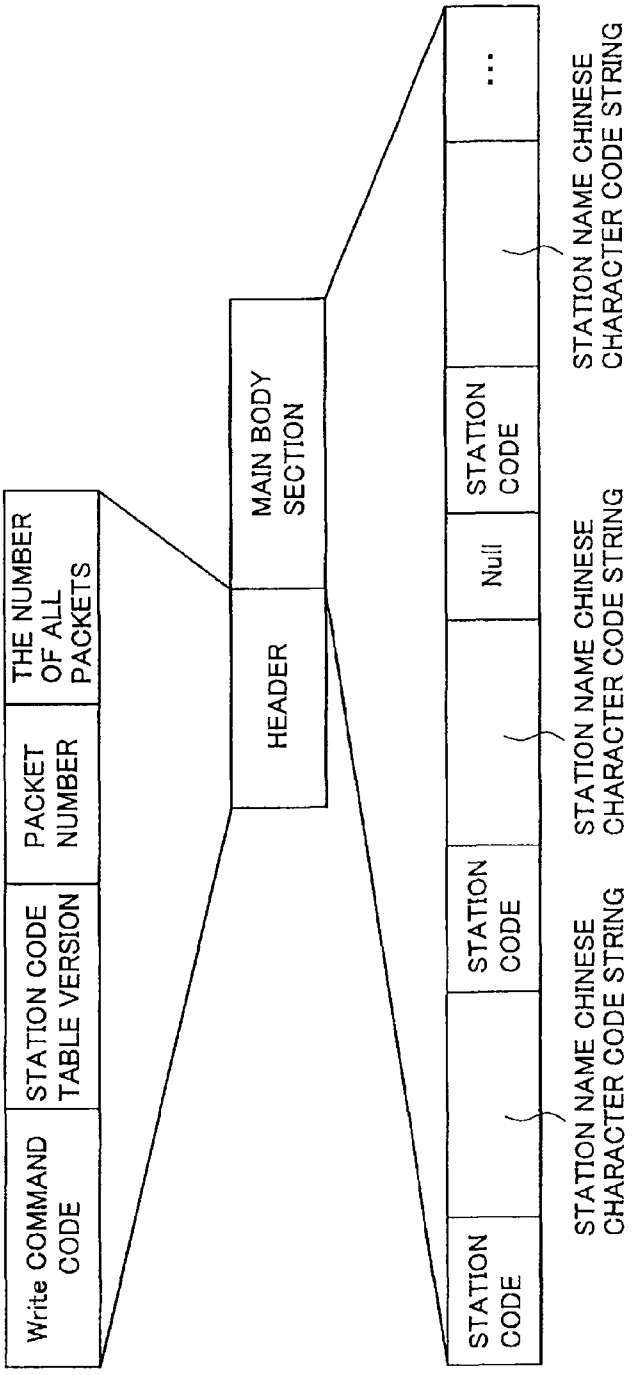

Write COMMAND CODE
STATION CODE TABLE VERSION
PACKET NUMBER
THE NUMBER OF ALL PACKETS
HEADER
MAIN BODY SECTION
STATION CODE
STATION NAME CHINESE CHARACTER CODE STRING
STATION CODE
STATION NAME CHINESE CHARACTER CODE STRING
Null
STATION CODE
STATION NAME CHINESE CHARACTER CODE STRING
...

FIG.8A

Status COMMAND CODE
STATION CODE TABLE VERSION
PACKET NUMBER
THE NUMBER OF ALL PACKETS
RETRANSMITTED

FIG.8B

FIG.9A

STATION CODE	STATION NAME CHINESE CHARACTER CODE STRING
0001	TOKYO
0002	SHINAGAWA
0003	YOKOHAMA
⋮	⋮

FIG.9B

TRAIN CODE	TRAIN CHINESE CHARACTER CODE STRING
0001	NOZOMI
0002	HIKARI
0003	KODAMA
⋮	⋮

INFORMATION PROCESSING APPARATUS, INFORMATION PROCESSING SYSTEM, INFORMATION PROCESSING METHOD AND PROGRAM

CROSS-REFERENCE TO RELATED APPLICATION

The present invention contains subject matter related to Japanese Patent Application JP 2008-29739 filed in the Japan Patent Office on Feb. 8, 2008, the entire contents of which being incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to information processing apparatus, information processing system, information processing method and program.

2. Description of the Related Art

Non-contact IC cards contain an integrated circuit (IC chip) and an antenna, and can carry out near field wireless communication with another device (for example, reader/writer). Since the non-contact IC cards are portable and have high reliability, they are mostly used for authenticating or clearing up ID cards, credit cards or point cards and the like.

In recent years, it is considered that a display device is provided to surfaces of the non-contact IC cards. The display devices display information stored in IC chips, such as ID information, balance information or history information. As a result, convenience for using cards is improved. For example, Japanese Patent Application Laid-Open No. 2006-208582 discloses a technique that a display device is provided to the surface of the non-contact IC cards.

IC chips included in non-contact IC cards used generally at the present do not have a display function corresponding to the display devices. For this reason, in order to provide the display device to the non-contact IC cards, the existing IC chips can be hardly directly diverted. Therefore, it is considered that new IC chips having the display function are developed. However, the development of new IC chips costs a lot, and it is difficult to spread new IC chips instead of already spread IC chips.

Therefore, in order to realize a non-contact IC card provided with a display device, the non-contact IC card is provided with an IC chip of existing non-contact IC cards, a display device, and a control IC which can control the display device. The control IC reads information stored in the IC chip, and displays the read information on the display device. According to this method, the existing technique is used so that the non-contact IC card having the display device can be realized.

At this time, data to be displayed on the display device of the non-contact IC card should be read from a reader/writer via the IC chip. It is difficult to store large-capacity data for display in existing IC chips, and the data should be transferred to the control IC for the display device immediately. In view of convenience of the non-contact IC card, since a memory capacity is repressed and simultaneously communication time is shortened, the data capacity of the display data should be reduced.

SUMMARY OF THE INVENTION

In order to solve the above issue, it is desirable to provide new and improved information processing apparatus, information processing system, information processing method and program which can store display data efficiently.

According to an embodiment of the present invention, there is provided an information processing apparatus including: a receiving section which receives a magnetic field signal; a first storage section which stores display data contained in the magnetic field signal and data conversion information for converting the display data into information displayable on a display section therein; a reading section which reads the display data and the data conversion information stored in the first storage section; a detecting section which detects a carrier wave near the receiving section; a switching control section which controls a switching section so as to, when the detecting section detects the carrier wave, switch connecting destination of the first storage section into the receiving section, and when the detecting section does not detect the carrier wave, switch the connecting destination of the first storage section into the reading section; a second storage section which stores the data conversion information read by the reading section; and a display control section which converts the read display data using the data conversion information stored in the second storage section, so as to display the information on the display section.

When the data conversion information contained in the magnetic field signal received by the receiving section is updated from the data conversion information already stored in the second storage section, the reading section reads the data conversion information stored in the first storage section, and the second storage section may update the data conversion information already stored into updated data conversion information.

Furthermore, according to another embodiment of the present invention, there is provided an information processing system including: a first device which receives data via wireless communication and stores the data therein; and a second device which transmits/receives the data to/from the first device, wherein the first device includes: a receiving section which receives a magnetic field signal; a first storage section which stores display data contained in the magnetic field signal and data conversion information for converting the display data into information displayable on a display section therein; a reading section which reads the display data and the data conversion information stored in the first storage section; a detecting section which detects a carrier wave near the receiving section; a switching control section which controls a switching section so as to, when the detecting section detects the carrier wave, switch connecting destination of the first storage section into the receiving section, and when the detecting section does not detect the carrier wave, switch the connecting destination of the first storage section into the reading section; a second storage section which stores the data conversion information read by the reading section therein; and a display control section which converts the read display data using the data conversion information stored in the second storage section, so as to display the information on the display section, the second device starts or interrupts transmission of a carrier wave at any timing.

Furthermore, according to another embodiment of the present invention, there is provided an information processing method including the steps of: receiving a magnetic field signal by means of a receiving section; storing display data contained in the magnetic field signal and data conversion information for converting the display data into information displayable on a display section in a first storage section; reading the display data and the data conversion information stored in the first storage section; detecting a carrier wave near the receiving section; controlling a switching section so that

when the carrier wave is detected, connecting destination of the first storage section is switched into the receiving section, and when the carrier wave is not detected, the connecting destination of the first storage section is switched into a reading section; storing the read data conversion information in a second storage section; and converting the read display data using the data conversion information stored in the second storage section and displaying the information on a display section.

Furthermore, according to another embodiment of the present invention, there is provided a program which allows a computer to function as: a unit which receives a magnetic field signal by means of a receiving section; a unit which stores display data contained in the magnetic field signal and data conversion information for converting the display data into information displayable on a display section in a first storage section; a unit which reads the display data and the data conversion information stored in the first storage section; a unit which detects a carrier wave near the receiving section; a unit which controls a switching section so that when the carrier wave is detected, connecting destination of the first storage section is switched into the receiving section, and when the carrier wave is not detected, the connecting destination of the first storage section is switched into a reading section; a unit which stores the read data conversion information in a second storage section; and a unit which converts the read display data using the data conversion information stored in the second storage section and displays the information on the display section.

According to the present invention, the display data can be stored efficiently.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a non-contact IC card according to one embodiment of the present invention;

FIG. **2** is a block diagram illustrating a display control section of the non-contact IC card according to the embodiment;

FIG. **3** is a flow chart illustrating switching of an electron switch;

FIG. **4** is a flow chart illustrating a flow of data to be transmitted from a reader/writer to the non-contact IC card;

FIG. **5** is a flow chart illustrating a command process at the time of transmitting data to the non-contact IC card from the reader/writer;

FIG. **6** is a flow chart illustrating a data process at the time of transmitting a command to the non-contact IC card section by the reader/writer;

FIG. **7** is a flow chart illustrating a command process from the reader/writer to the non-contact IC card;

FIGS. **8**A and **8**B are explanatory diagrams illustrating data structures of packet data; and

FIGS. **9**A and **9**B are explanatory diagrams illustrating data conversion tables stored in a storage section of a display control section.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the appended drawings. Note that, in this specification and the appended drawings, structural elements that have substantially the same function and structure are denoted with the same reference numerals, and repeated explanation of these structural elements is omitted.

A non-contact IC card **100** (first device) is used for tickets or the like to be used in railway companies. The non-contact IC card **100** receives data from a reader/writer **10** (second device) and stores the received data therein. The non-contact IC card **100** has a display section **130** and can display the stored data to an outside. The data acquired by the non-contact IC card **100** includes information relating to a reserved-seat ticket (display data), data conversion table (data conversion information) and the like.

The data conversion table stored in a storage section **125** of a display control section **120** is described with reference to FIGS. **9**A and **9**B. FIGS. **9**A and **9**B are explanatory diagrams illustrating the data conversion tables stored in the storage section **125** of the display control section **120**.

The data conversion table is a table for converting codes into characters which can be displayed on the display section **130**. The data conversion table includes a data conversion table for converting station codes into station names as shown in FIG. **9**A, and a data conversion table for converting train codes into train names as shown in FIG. **9**B.

A total data amount of the data to be transmitted from the reader/writer **10** to the non-contact IC card **100** can be reduced by using the data conversion table. This is described in detail below.

When information about a reserved-seat ticket is displayed on the display section **130**, information necessary for the display includes information about a departure station, an arrival station, a departure date, an arrival date, a train name, a seat number, a publication date, an expiration date and money amount. These pieces of information may be transmitted as bit map type image data, but the data amount becomes enormous.

For this reason, predetermined station codes and train codes are used, and the data conversion tables shown in FIGS. **9**A and **9**B are stored in the storage section **125** of the display control section **120**. As a result, the non-contact IC card **100** can receive necessary information with less data amount from the reader/writer **10**.

The data conversion tables stored in the storage section **125** of the display control section **120** should be updated when station names and train names are added or changed. Since the display control section **120** does not have a communication unit, the data conversion tables should be updated via a non-contact IC card section **110**. Therefore, the updated data in the data conversion tables is received from the reader/writer **10**, and in the case of a new table data, the table data in the storage section **125** is updated as described below.

Structure According to One Embodiment

The non-contact IC card **100** according to one embodiment of the present invention is described with reference to FIG. **1**. FIG. **1** is a block diagram illustrating the non-contact IC card **100** according to the embodiment.

The non-contact IC card **100** according to the embodiment includes a power source supply section **102**, the non-contact IC card section **110**, the display control section **120**, the display section **130**, the electron switch **140**, a magnetic field sensor **142**, and a loop antenna **144**.

The power source supply section **102** supplies an electric power to respective structural elements contained in the non-contact IC card **100**, such as the non-contact IC card section **110**, the display control section **120**, the display section **130** and the electron switch **140**. An electric power is supplied to the non-contact IC card section **110**, but the non-contact IC card **100** according to the embodiment shown in FIG. **1** is not limited to this example. For example, the electric power may

be supplied to the non-contact IC card section **110** by a signal to be supplied from the reader/writer **10**. At this time, the power source supply section **102** does not supply an electric power to the non-contact IC card section **110** but supplies an electric power to the display control section **120**, the display section **130** and the electron switch **140**.

The non-contact IC card section **110** executes a control process and an arithmetic process for realizing the functions as the non-contact IC card **100**. The non-contact IC card section **110** is provided as a semiconductor integrated circuit (IC chip) to the inside of the non-contact IC card **100**.

The non-contact IC card section **110** has a storage section **112** (first storage section). The storage section **112** is, for example, EEPROM (Electronically Erasable and Programmable Read Only Memory). The non-contact IC card section **110** receives information contained in a signal transmitted from the reader/writer via the loop antenna **144**, and the storage section **112** stores the information therein.

The non-contact IC card section **110** reads the information stored in the storage section **112** based on a request from the reader/writer **10** or the display control section **120**, and transmits the information to the reader/writer **10** or the display control section **120**.

The information to be stored in the storage section **112** is, for example, data about a ticket and a data conversion information.

The display control section **120** controls display on the display section **130**. The display control section **120** acquires information stored in the storage section **112** from the non-contact IC card section **110** via the electron switch **140**, and displays that information or information generated based on the information on the display section **130**. The display control section **120** is one example of a reading section.

The display control section **120** controls the electron switch **140** based on a detected result of a magnetic field supplied from the magnetic field sensor **142**. For example, when the magnetic field sensor **142** detects a carrier wave, the display control section **120** controls the electron switch **140** so that a connecting destination of the non-contact IC card section **110** is switched into the loop antenna **144**. This control enables communication between the non-contact IC card **100** and the reader/writer **10**. On the other hand, since the display control section **120** is disconnected from the non-contact IC card section **110**, it can hardly acquire information from the non-contact IC card section **110**.

When the magnetic field sensor **142** does not detect the carrier wave, the display control section **120** controls to switch the connecting destination of the non-contact IC card section **110** into the display control section **120**. This control disables the communication between the non-contact IC card **100** and the reader/writer **10**. On the other hand, since the display control section is connected to the non-contact IC card section **110**, it can acquire information from the non-contact IC card section **110**. The display control section **120** is one example of a switching control section.

The display control section **120** has the storage section **125** (second storage section). The storage section **125** is, for example, EEPROM (Electronically Erasable and Programmable Read Only Memory). The display control section **120** receives information from the non-contact IC card section **110** and the storage section **125** stores the information therein. As a result, the display control section **120** can display the information acquired from the non-contact IC card section **110** on the display section **130** at any timing.

The display section **130** is, for example, LCD (Liquid Crystal Display) and organic EL (Electro-Luminescence) display, and can display characters and images. The display section **130** may have a shape and a size such that convenience as the non-contact IC card **100** can be provided.

The electron switch **140** is one example of a switching section, and a switching circuit which switches a connecting destination of a signal input/output terminal of the non-contact IC card section **110**. The electron switch **140** is, for example, a three-terminal switch, and connects the non-contact IC card section **110** to any one of the loop antenna **144** or the display control section **120**. The electron switch **140** is controlled by the display control section **120**. The electron switch **140** may have any structure and scale such that convenience as the non-contact IC card **100** can be provided.

The magnetic field sensor **142** is one example of a detecting section, and is provided near the loop antenna **144**. The magnetic field sensor **142** detects a change in a magnetic field generated near the loop antenna **144**. The magnetic field sensor **142** transmits the detected result to the display control section **120**. The magnetic field sensor **142** is for detecting a magnetic field signal transmitted from the reader/writer **10**, and its detecting ability for a change in the magnetic field may be approximated or matched with the loop antenna **144**. For example, the magnetic field sensor **142** has a coil shape which is similar to that of the loop antenna **144**, and is disposed to be insulated from and superimposed on the loop antenna **144**.

The loop antenna **144** is one example of a receiving section, and receives a magnetic field signal. The loop antenna **144** detects and receives a change in a magnetic field inside the loop due to an electromagnetic wave (carrier wave) transmitted from the reader/writer **10** close to the non-contact IC card **100**. The loop antenna **144** transmits the received signal to the non-contact IC card section **110** via the electron switch **140**.

The display control section **120** according to the embodiment is described in detail below with reference to FIG. **2**. FIG. **2** is a block diagram illustrating the display control section **120** of the non-contact IC card **100** according to the embodiment.

The display control section **120** includes a condition determining section **121**, an electron switch control section **122**, a display data transmission/reception section **123**, a storage control section **124** and the storage section **125**.

The condition determining section **121** determines whether the result detected by the magnetic field sensor **142** satisfies a predetermined condition. For example, the predetermined condition is presence/non-presence of detection of the change in a magnetic field. When the change in the magnetic field is detected, the determination is made that the condition is satisfied. When the change in the magnetic field is not detected, the condition is not satisfied.

The electron switch control section **122** controls the electron switch **140** according to the determined result of the condition determining section **121**. For example, when the condition determining section **121** detects a carrier wave and determines that condition is satisfied, the electron switch control section **122** controls the electron switch **140** so that the connecting destination of the non-contact IC card section **110** is switched into the loop antenna **144**. On the other hand, when the condition determining section **121** does not detect a carrier wave and determines that the condition is not satisfied, the electron switch control section **122** controls the electron switch **140** so that the connecting destination of the non-contact IC card section **110** is switched into the display control section **120**.

The display data transmission/reception section **123** receives information such as display data or data conversion information from the non-contact IC card section **110** via the electron switch **140** so as to transmit information for display to the display section **130**.

The storage control section **124** makes a control so that the information such as display data or data conversion information is written into the storage section **125** or the information such as display data or data conversion information stored in the storage section **125** is read.

The series of processes may be executed by hardware or software using a program on a computer.

Operation According to One Embodiment

An operation of the non-contact IC card **100** according to the embodiment is described below with reference to FIGS. **3** to **7**.

Switching of the electron switch **140** is described with reference to FIG. **3**. FIG. **3** is a flow chart illustrating the switching of the electron switch **140**. Normally the non-contact IC card **100** is approximated to the reader/writer **10** so as to detect a change in a magnetic field, and accordingly the electron switch **140** switches connecting destination.

The magnetic field sensor **142** contained in the non-contact IC card **100** detects a change in a magnetic field (step S**11**). The condition determining section **121** of the display control section **120** determines whether the predetermined condition is satisfied (steps S**12** and S**13**). When the predetermined condition is satisfied, for example, when a carrier wave from the reader/writer **10** is detected, the electron switch **142** of the display control section **120** is connected to the loop antenna **144** (step S**16**). At this time, the non-contact IC card **100** can receive data from the reader/writer **10** (step S**17**). The storage section **112** of the non-contact IC card section **110** stores the received data therein.

On the other hand, when the predetermined condition is not satisfied, for example, when the carrier wave from the reader/writer **10** is not detected, the electron switch **142** of the display control section **120** is connected to the display control section **120** (step S**14**). At this time, the non-contact IC card **100** can transmit data from the non-contact IC card section **110** to the display control section **120** (step S**15**). The storage section **125** of the display control section **120** stores the data from the non-contact IC card section **110**.

The switching of the electron switch **140** is changed according to presence/non-presence of the detection of the carrier wave, and the non-contact IC card **100** receives the data from the reader/writer **10** or transmits the data stored in the non-contact IC card section **110** to the display control section **120**. As a result, while the existing non-contact IC card section **110** is being utilized, the data is transmitted to the display control section **120** and information can be displayed on the display section **120**.

The flow of the data to be transmitted from the reader/writer **10** to the non-contact IC card **100** is described below with reference to FIG. **4**. FIG. **4** is a flow chart illustrating the flow of the data to be transmitted from the reader/writer **10** to the non-contact IC card **100**.

The reader/writer **10** receives data from the controller **20** (a computer server apparatus or a computer terminal) connected to the reader/writer **10** (step S**21**). When the non-contact IC card **100** according to the embodiment is used as a ticket or a reserved-seat ticket of a railway company, the reader/writer **10** receives reserved-seat ticket data or conversion table updated data from the controller **20**.

When the non-contact IC card **100** is approximated to the reader/writer **10** and detects a carrier wave, the electron switch **140** of the non-contact IC card **100** is connected to the loop antenna **144** like step S**16** in FIG. **1**. The non-contact IC card **100** receives the reserved-seat ticket data or the conversion table updated data from the reader/writer **10** (step S**22**). The reserved-seat ticket data received from the reader/writer **10** is stored in the storage section **112** of the non-contact IC card section **110** (step S**23**).

On the other hand, as to the conversion table updated data received from the reader/writer **10**, a version of the data conversion table (old or new data) stored in the storage section **125** of the display control section **120** is determined. When the conversion table updated data is newer than the data conversion table stored in the storage section **125**, the display control section **120** reads the conversion table updated data (step S**24**). This reading is carried out when the carrier wave is not detected, and the electron switch **140** of the non-contact IC card **100** is connected to the display control section **120** like step S**14**. The data conversion table stored in the storage section **125** is updated (step S**25**).

When the reserved-seat ticket data is displayed on the display section **130**, the display control section **120** reads the reserved-seat ticket data stored in the storage section **112** of the non-contact IC card section **110** (step S**26**). The display control section **120** converts a station name and a train name into displayable data according to the reserved-seat ticket data by using the data conversion table stored in the storage section **125**, and displays the data on the display section **130** (step S**27**).

The reserved-seat ticket data and the conversion table updated data are transmitted from the reader/writer **10** to the non-contact IC card **100**, so that the data about the reserved-seat ticket can be displayed on the display section **130** of the non-contact IC card **100**.

A command process at the time of transmitting data from the reader/writer **10** to the non-contact IC card **100** is described below with reference to FIG. **5**. FIG. **5** is a flow chart illustrating the command process at the time of transmitting data from the reader/writer **10** to the non-contact IC card **100**.

The reader/writer **10** transmits a carrier wave to the non-contact IC card **100** (step S**31**). When the non-contact IC card **100** is approximated to the reader/writer **10**, a determination is made that the carrier wave is detected in the display control section **120** (step S**32**). As a result, the display control section **120** controls the electron switch **140** so as to connect the electron switch **140** to the loop antenna **144** (step S**33**). In this state, the non-contact IC card section **110** can receive the data from the reader/writer **10**.

The reader/writer **10** starts to request the non-contact IC card section **110** for a data writing process (step S**34**), and transmits a data writing command to the non-contact IC card section **110** (step S**35**). The non-contact IC card section **110** responds to the reader/writer as to the data writing (step S**37**). The non-contact IC card section **110** which receives the data writing command executes the command process (step S**36**). As a result, data such as the reserved-seat ticket data or the conversion table updated data is written into the non-contact IC card section **110**.

For example, when a data capacity of the conversion table updated data is large, it is difficult to write the entire data into the non-contact IC card section **110** at a time. Therefore, when reception of a part of data is completed, the reception of the data from the reader/writer is once stopped, and the data stored in the storage section **112** of the non-contact IC card section **110** may be transferred to the storage section **125** of the display control section **120**.

Namely, after the reader/writer **10** receives a response of step S**37** from the non-contact IC card section **110**, the transmission of the carrier wave is interrupted (step S**38**). As a result, the non-contact IC card **100** determines that the carrier wave is not detected in the display control section **120** (step

S39). As a result, the display control section **120** controls the electron switch **140** so as to connect the electron switch **140** to the display control section **120** (step S40). In this state, the non-contact IC card section **110** can transmit data to the display control section **120**.

The display control section **120** starts to request the non-contact IC card section **110** for the data reading process (step S41), and transmits the data reading command to the non-contact IC card section **110** (step S42). The non-contact IC card section **110** which receives the data reading command executes the command process (step S43). As a result, data is read from the storage section **112** of the non-contact IC card section **110**, and the non-contact IC card section **110** responds to the display control section **120** (step S44). Data such as the reserved-seat ticket data or the conversion table updated data is written into the display control section **120** (step S45). At this time, packet data shown in FIG. **8**A is transmitted from the non-contact IC card section **110** to the display control section **120**. FIG. **8**A is an explanatory diagram illustrating a data structure of the packet data.

Thereafter, the reader/writer **10** again transmits the carrier wave to the non-contact IC card section **110**, and writes continued data after data recorded partway in the non-contact IC card section **110**. When steps **31** to S45 are repeated, the writing of the conversion table updated data of a large data capacity into the display control section **120** is completed (step S46).

When the reader/writer **10** interrupts the transmission of the carrier wave, the data is transmitted from the storage section **112** of the non-contact IC card section **110** to the storage section **125** of the display control section **120**. For this reason, data of large amount can be stored in the display control section **120** via the non-contact IC card section **110** without enlarging a memory capacity of the storage section **112** of the non-contact IC card section **110**. As a result, even when the exiting non-contact IC card section **110** is used, the data of large capacity can be received.

A data process at the time of transmitting a command from the reader/writer **10** to the non-contact IC card section **110** is described in detail below with reference to FIG. **6**. FIG. **6** is a flow chart illustrating the data process at the time of transmitting a command from the reader/writer **10** to the non-contact IC card section **110**.

Like step S34 in FIG. **5**, when the reader/writer **10** requests the non-contact IC card section **110** to execute a writing process, the reader/writer **10** transmits a polling command to the non-contact IC card section **110** (step S51). On the contrary, the non-contact IC card section **110** transmits ID (identification information) specific to the non-contact IC card section **110** to the reader/writer **10** (step S52).

The reader/writer **10** stores the received ID specific to the non-contact IC card section **110** (step S53). The reader/writer **10** specifies the received ID specific to the non-contact IC card section **110** and transmits a command (step S35). When the non-contact IC card section **110** receives the command, it determines whether the ID of the non-contact IC card attached to the command agrees with self specific ID (step S54). When they match with each other, the non-contact IC card section **110** responds to the reader/writer **10** (step S37), and executes the command process such as the writing process. On the other hand, when they do not agree with each other, the non-contact IC card section **110** does not respond to the reader/writer **10** (step S55).

As a result, even when a plurality of commands is transmitted from the reader/writer **10**, the non-contact IC card section **110** may respond only to a command specified by the self ID. As a result, the non-contact IC card **100** can securely execute the command process.

When the reader/writer **10** corresponds one-to-one with the non-contact IC card section **110**, for example, when the non-contact IC card **100** is inserted into a ticket-vending machine which exchanges information only with one non-contact IC card **100**, after a polling command is transmitted at the first time, the polling command for specifying the non-contact IC card **100** does not have to be transmitted each time. That is to say, as shown in FIG. **5**, in the case where the transmission of a carrier wave is started or interrupted, when the command at step S35 is transmitted, the polling command may be transmitted only at the first time. When the writing of data is repeated at step S46, essentially the polling command should be transmitted each time. However, since the reader/writer **10** continuously executes a process on the one non-contact IC card section **110**, it can execute the command process at step S35 without transmitting the polling command.

According to the above description, when the data of large data amount is stored in the display control section **120** via the non-contact IC card section **110**, a procedure for transmitting the polling command can be omitted. For this reason, the data can be transmitted quickly.

A process in the case where since the transmission/reception of the data is interrupted, only a part of data is stored in the display control section **120** is described below with reference to FIG. **7**. FIG. **7** is a flow chart illustrating the command process from the reader/writer **10** to the non-contact IC card **100**. At this time, the reader/writer **10** does not retransmits the data from the beginning to the display control section **120** but can transmit the data partway.

That is to say, the reader/writer **10** starts to request the non-contact IC card section **110** for the data writing process (step S61), and transmits the data writing command to the non-contact IC card section **110** (step S62). The non-contact IC card section **110** which receives the data writing command executes the command process (step S63). When the non-contact IC card section **110** responds to the reader/writer as to confirmation of the completion of the data writing (step S64), the reader/writer **10** stops the transmission of the carrier wave (step S65). As a result, the non-contact IC card **100** determines that the display control section **120** does not detect the carrier wave (step S66). As a result, the display control section **120** controls the electron switch **140** so as to connect the electron switch **140** to the display control section **120** (step S67).

When the display control section **120** determines that only a part of data is stored, it starts to request for a data retransmitting process (step S68). At this time, the display control section **120** transmits packet data shown in FIG. **8**B to the non-contact IC card section **110**. The non-contact IC card section **110** which receives the command transmits the data retransmission request to the reader/writer **10** (step S71), and responds to the display control section **120** (step S72).

The reader/writer **10** which receives the data retransmission request starts the transmission of the carrier wave (step S73). The reader/writer **10** requests the display control section **120** to execute the process for writing specified part of the data (step S74). Thereafter, the process is executed similarly to steps after step S34 shown in FIG. **5**, and the writing of the entire data into the storage section **125** of the display control section **120** is completed.

It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alternations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

What is claimed is:

1. An information processing apparatus comprising:
a receiving circuit which receives a magnetic field signal;
a first storage circuit which stores display data contained in the magnetic field signal and data conversion information associating the display data to predetermined displayable information;
a reading circuit which reads the display data and the data conversion information stored in the first storage circuit;
a second storage circuit which stores the data conversion information read by the reading circuit;
a switch to connect the first storage circuit to one of the receiving circuit and the reading circuit;
a detecting circuit which detects a carrier wave near the receiving circuit;
a display control circuit to
cause the switch to connect the first storage circuit to the receiving circuit, when the detecting circuit detects the carrier wave,
cause the switch to connect the first storage circuit to the reading circuit, when the detecting circuit does not detect the carrier wave, and
to convert the display data, read from the first storage circuit by the reading circuit, by reading displayable information associated with the display data in the data conversion information stored in the second storage circuit;
a display to display the displayable information associated with the display data; and
a processing circuit to process information stored in the first storage circuit based on a command received by the receiving circuit via the carrier wave, when the command includes identification information identifying the information processing apparatus, the received command including version information of the data conversion information to be used by the processing circuit to process the information stored in the first storage circuit.

2. The information processing apparatus according to claim 1, wherein when the data conversion information contained in the magnetic field signal received by the receiving circuit is updated based on the data conversion information stored in the second storage circuit,
the reading circuit reads the data conversion information stored in the first storage circuit, and
the second storage circuit updates the data conversion information already stored into the updated data conversion information.

3. The information processing apparatus according to claim 1, wherein the receiving circuit is a loop antenna.

4. The information processing apparatus according to claim 3, wherein the detecting circuit detects the carrier wave by detecting an electromagnetic field.

5. The information processing apparatus according to claim 4 wherein the detecting circuit includes an antenna separate from the loop antenna.

6. The information processing apparatus according to claim 1, wherein at least a portion of the information processing apparatus is powered by the magnetic field signal.

7. The information processing apparatus according to claim 1, wherein the display is a liquid crystal display.

8. The information processing apparatus according to claim 1, wherein the information processing apparatus is a non-contact IC card.

9. The information processing apparatus according to claim 8, wherein the magnetic field signal further includes financial transaction data.

10. The information processing apparatus according to claim 1, wherein the data conversion information includes a table that stores codes in association with information displayable on the display, the display data corresponding to the codes.

11. The information processing apparatus according to claim 10, wherein the information displayable on the display include train station and train schedule information.

12. The information processing apparatus according to claim 1, wherein the processing circuit does not process the information stored in the first storage circuit when the command received by the receiving circuit does not include information identifying the information processing apparatus.

13. The information processing apparatus according to claim 1, wherein the switch is an electron switch.

14. An information processing system comprising:
a first device which receives data via wireless communication and stores the data therein; and
a second device which transmits/receives the data to/from the first device;
wherein the first device includes:
a receiving circuit which receives a magnetic field signal;
a first storage circuit which stores display data contained in the magnetic field signal and data conversion information associating the display data to predetermined displayable information;
a reading circuit which reads the display data and the data conversion information stored in the first storage circuit;
a second storage circuit which stores the data conversion information read by the reading circuit;
a switch to connect the first storage circuit to one of the receiving circuit and the reading circuit;
a detecting circuit which detects a carrier wave near the receiving circuit;
a display control circuit to
cause the switch to connect the first storage circuit to the receiving circuit, when the detecting circuit detects the carrier wave, and
cause the switch to connect the first storage circuit to the reading circuit, when the detecting circuit does not detect the carrier wave, and
convert the display data, read from the first storage circuit by the reading circuit, by reading displayable information associated with the display data in the data conversion information stored in the second storage circuit;
a display to display the displayable information associated with the display data; and
a processing circuit to process information stored in the first storage circuit based on a command received by the receiving circuit from the second device, when the receiving circuit receives identification information identifying the first device, the received command including version information of the data conversion information to be used by the processing circuit to process the information stored in the first storage circuit,
wherein the second device starts or interrupts transmission of a carrier wave at any timing.

15. An information processing method comprising:
receiving a magnetic field signal via a receiving circuit;
storing display data contained in the magnetic field signal and data conversion information associating the display data to predetermined displayable information in a first storage circuit;
reading the display data and the data conversion information stored in the first storage circuit;
detecting a carrier wave near the receiving circuit;

connecting the first storage circuit to the receiving circuit, when the carrier wave is detected;

connecting the first storage circuit to the reading circuit, when the carrier wave is not detected;

storing the read data conversion information in a second storage circuit;

converting the display data, read from the first storage circuit by the reading circuit, by reading displayable information associated with the display data in the data conversion information stored in the second storage circuit;

displaying the displayable information associated with the display data on a display; and

processing information stored in the first storage circuit based on a command received in the carried wave, when the received command also includes identification information corresponding to identification information stored in the first storage circuit, the received command including version information of the data conversion information to be used in processing of the information stored in the first storage circuit.

16. A non-transitory computer-readable medium encoded with computer-readable instructions thereon, the computer-readable instructions when executed by a computer cause the computer to perform a method comprising:

receiving a magnetic field signal at a receiving circuit;

storing, in a first storage circuit, display data contained in the magnetic field signal and data conversion information associating the display data to predetermined displayable information;

reading the display data and the data conversion information stored in the first storage circuit;

detecting a carrier wave near the receiving circuit;

connecting the first storage circuit to the receiving circuit, when the carrier wave is detected;

connecting the first storage circuit to the reading circuit, when the carrier wave is not detected;

storing the read data conversion information in a second storage circuit;

converting the display data, read from the first storage circuit by the reading circuit, by reading displayable information associated with the display data in the data conversion information stored in the second storage circuit;

displaying the display data displayable information associated with the on the display; and

processing information stored in the first storage circuit based on a command received in the carried wave, when the received command also includes identification information corresponding to identification information stored in the first storage circuit, the received command including version information of the data conversion information to be used in processing of the information stored in the first storage circuit.

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